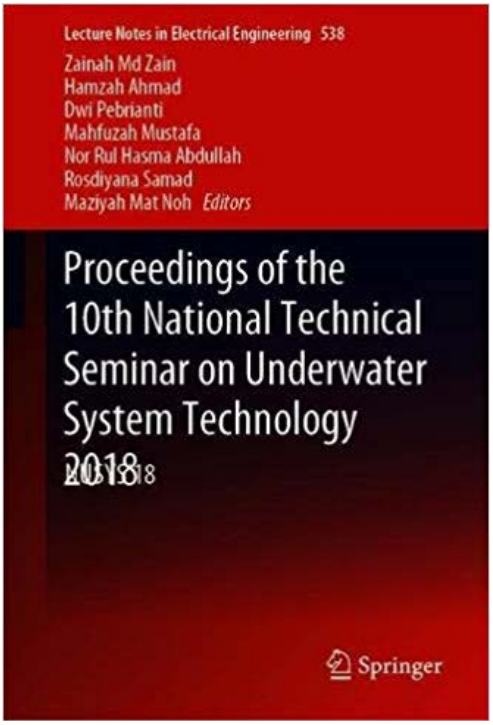

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Contents

Parameter (Voltage, Current, Time) study for thermoelectric cooler (TEC) automobile air-conditioner

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Abstract. This research is designed to build a controller to control the cold side temperature of thermoelectric material called Thermoelectric Coolers (TECs). This work deals with a useful control scheme to impose a user defined cold temperature on an airconditioning used as cold sources for Thermoelectric Coolings characterization. These devices used in both power supply and cooler configurations. During the experiments, the thermoelectric material was driven two ways, by manually supply voltage using a power supply and then by a PWM signal generated by an Arduino-UNO board on which the ON-OFF controller is implemented. This work includes major results of tests that were conducted in order to identify the relationship between voltage and current flow in the TECs module to temperature gradient of two surfaces and the time required to cool ambient air & impact of different cooling methods to remove heat from TECs surfaces.

Keywords: thermoelectric material, thermoelectric coolings

1 Introduction

Thermoelectric cooling (TEC), works by the Peltier effect, as 12V DC of battery is supply to the TEC module, heat will be absorbed at one junction and release at the other junction. The direction of heat flow is regulated based on the direction of the supply DC power source, one surface of TEC absorbs heat making surface cold and the opposites sides gets heated [1]. This phenomenon can be described using Peltier effect. The minimum temperature that can be obtained through the cold surface depends upon certain factors including ambient temperature, voltage supplied, cooling mechanisms used in surfaces and quality of the TEC module. Depending on the application TECs should be used in an optimum way.

A TEC contains two plates made of ceramic. An array of p-type and n-type semiconductor couple is placed in between the two ceramic plates. These elements are arranged electrically series and thermal parallel [1], [3-4]. When a positive DC voltage is supplied to n-type semiconductor electrons will pass from p-type thermos element to n-type thermos element causing heat reduction in cold surface and increased heat in hot surface. The rate of heat absorption is proportional to number of thermoelectric couples and amount of current applied. A typical TEC (Laird XA19) would contain 127 thermoelectric couples [6].